Test Report acc. to FCC Title 47 CFR Part 15
relating to
Hammer-IMS nv
Rio

Title 47 – Telecommunication
Part 15 - Radio Frequency Devices
Subpart C – Intentional Radiators
Measurement Procedure:
ANSI C63.4-2014
ANSI C63.10-2013

DAkkS Deutsche Akkreditierungsstelle D-PL-12053-01-03

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
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MANUFACTURER	
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RELEVANT STANDARD	
Title	**47 - Telecommunication**
Part	**15 - Radio Frequency Devices**
Subpart	**Subpart C – Intentional Radiators - Section 15.255**
Measurement procedure	**ANSI C63.10-2013**

EQUIPMENT UNDER TEST (EUT)	
Equipment category	Field disturbance sensor
Trade name	Hammer-IMS
Type designation	**Rio**
Serial no.	BA020019
Variants	---

Test result summary

Clause	FCC Rules	Requirements headline	Test result		
8.1	§ 15.203	Antenna requirement	**Pass**	~~Fail~~	~~N.t.~~*
8.2	§ 15.207 (a)	AC power line conducted limits	**Pass**	~~Fail~~	~~N.t.~~*
8.3	§ 15.255 (c)	Radiated power (EIRP)	**Pass**	~~Fail~~	~~N.t.~~*
8.4	§ 15.255 (e)	Peak conducted output power	**Pass**	~~Fail~~	~~N.t.~~*
8.5	§ 15.255 (d)	Transmitter spurious emission	**Pass**	~~Fail~~	~~N.t.~~*
8.6	§ 15.255 (e) (1)	Occupied Bandwidth	**Pass**	~~Fail~~	~~N.t.~~*
8.7	§ 15.255 (f)	Frequency stability	**Pass**	~~Fail~~	~~N.t.~~*
8.8	§ 1.1310 & § 2.1091	RF radiation exposure	**Pass**	~~Fail~~	~~N.t.~~*

* Not tested

If statements on conformity are made in this report, decision rules according to DIN EN ISO / IEC 17025: 2018, 7.8.6 have been applied. If these decision-making rules are not already specified in the applied standards, procedure 1 according to IEC Guide 115 ed.1.0 2007 (accuracy method) was used in the measurement / test procedures on which this report is based.

The equipment passed all the conducted tests	**Yes**	~~No~~

Signature	TÜV NORD Digital unterschrieben von Shrestha Anup Datum: 2021.11.04 07:58:43 +01'00'	TÜV NORD Digital unterschrieben von Trepper Ralf Datum: 2021.11.04 07:56:28 +01'00'
Name	**Mr. Anup Shrestha**	**Mr. Ralf Trepper**
Date of issue	**2021-11-03**	**2021-11-03**

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1. Table of contents

Revision	Date of issue	Creator	Content of change
00	2021.09.08	RT	Initial release
01	2021.09.17	RT	Further descriptions added
02	2021.10.07	RT	Corrections
03	2021.11.03	RT	Additional measurement results acc. to § 15.207 (a)

Table 0-1: Table of contents

Note: If the document has been changed by revision number, all previous documents are no longer valid and must be destroyed.

2. Introduction

This test report **is not an expert opinion** and consists of:

- Test result summary
- List of contents
- Introduction and further information
- Performance assessment
- Detailed test information

All pages have been numbered consecutively and bear the TÜV NORD Hochfrequenztechnik GmbH & Co. KG logo, the test report number, the date, the test specification in its current version as well as the type designation of the EUT. The total numbers of pages in this report is **44**.

The tests were carried out in a representative assembly and in accordance with the test methods and/or requirements stated in:

FCC Title 47 CFR Part 15 Subpart C Section 15.255, ANSI C63.10-2013

The sample of the product was received on:

- 2021-04-20

The tests were carried out in the following period of time:

- 2021-07-12 - 2021-09-02

3. Testing laboratory

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Phone: +49 221 8888950

FCC Registration Number: 763407

Accredited by:

DAkkS Deutsche Akkreditierungsstelle GmbH
DAkkS accreditation number: D-PL-12053-01-00

4. Applicant

Company name	: Hammer-IMS nv
Address	: Kempische Steenweg 293, bus 36 3500 Hasselt
Country	: Belgium
Telephone	: +32 11 36 05 08
Fax	: ---
Email	: bart.goossens@hammer-ims.com
Date of order	: 2021-04-12
References	: Mr. Bart Goossens

5. Product

Sample of the following apparatus was submitted for testing:

Manufacturer	: Hammer-IMS
Trademark	: Hammer-IMS
Type designation	: RIO
Serial number	: BA020019
Hardware version	: Rio 1.2
Variant	: ---
Software release	: For processor IWR6843AOP: **V0.11** / For processor STM32F303RE: **V0.12**
Type of equipment	: Field disturbance sensor
Power used	: 6 to 48 V DC
Frequency used	: 61.75 GHz
Generated or used frequencies	: 8.0 MHz (crystal), 12.0 MHz (crystal), 40.0 MHz (crystal), 61.75 GHz (center frequency)
ITU emission class	: 3G10F0N
FCC ID	: 2A2S2-RIO

For issuing this report the following product documentation was used:

Title	Description	Version
Rio Installation Manual	Installation Manual	---
Technical manual for the Marveloc-CURTAIN product family	Technical manual	Version July 2021

For issuing this report the following product documentation was used:

Description	Date	Identifications
External photographs of the **E**quipment **U**nder **T**est (EUT)	2021-09-17	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2021-09-17	Annex no. 2
Channel occupancy / bandwidth	2021-09-17	Annex no. 3
Label sample	2021-09-17	Annex no. 4
Functional description / User Manual	2021-09-17	Annex no. 5
Test setup photos	2021-11-03	Annex no. 6
Block diagram	2021-09-17	Annex no. 7
Operational description	2021-09-17	Annex no. 8
Schematics	2021-09-17	Annex no. 9
Parts list	2021-09-17	Annex no. 10

6. Conclusions, observations and comments

The test report will be filed at TÜV NORD Hochfrequenztechnik GmbH & Co. KG for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of TÜV NORD Hochfrequenztechnik GmbH & Co. KG.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. TÜV NORD Hochfrequenztechnik GmbH & Co. KG cannot be held liable for properties of the EUT that have not been observed during these tests.

TÜV NORD Hochfrequenztechnik GmbH & Co. KG assumes the sample to comply with the requirements of FCC Title 47 CFR Part 15 for the respective test sector, if the test results turn out positive.

Comments: ---

7. Operational description

7.1 EUT details

The Rio module is the mm-wave basis-weight measurement device developed by Hammer-IMS. The board is equipped with a 60 GHz measurement transceiver. The measurement data is available on a proprietary RS485 interface. The Rio Module is installed in host devices of the Marveloc-CURTAIN product family. Installation should only be performed by qualified personnel.

7.2 EUT configuration

Test description for peak power, bandwidths and frequency stability measurements:
After applying the supply voltage, the device starts to work. No additional equipment or operating software is required
Test description for all emission measurements:
The Marveloc-CURTAIN is prepared as an permanently installed in an inline measuring situation, a panel pc is attached to it. This panel pc has the Connectivity 3.0 software suite to control the device. The Operator manual for the Marveloc CURTAIN product family used.

7.3 EUT measurement description

Radiated measurements
A maximum configuration of the Marveloc-CURTAIN with eight built-in Rio modules is used for the measurements. The EUT was tested in a typical fashion. During preliminary emission tests, the EUT was operated in the continuous measuring mode for worst case emission mode investigation. Therefore, the final qualification testing was completed with the EUT operated in continuous measuring mode. All tests were performed in a semi-anechoic chamber (SAC) with the EUT's typical voltage: 120 V AC.

In order to establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test samples, secondly the test ample have been rotated at all adjustments around the own axis between 0° and 360°, and thirdly, the antenna polarization between horizontal and vertical had been varied.

Radiated measurements from 9 kHz – 30 MHz, 30MHz – 1 GHz and above 1 GHz were performed using a small loop antenna, Linear polarized Logarithmic Periodic Broadband Antenna and stacked Logarithmic-Periodic Broadband Antenna for linear polarized respectively with a measuring distance of 10 or 3 m inside SAC.

Radiated measurements bove 1 GHz is made by placing loose-laid RF absorber material on the ground plane.

Additionally, radiated emission measurements above 1 GHz are made using calibrated linearly polarized antennas, which may have a smaller beam width (main lobe) than do the antennas used for frequencies below 1 GHz. The measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

AC Line Conducted measurements
A maximum configuration of the Marveloc-CURTAIN with eight built-in Rio modules is used for the measurements. The EUT was directly connected to the artificial mains network. It has been tested with the activated EUT in continuous measuring mode.

Environmental Conditions during the tests
Temperature: 21 – 26°C // Relative Humidity: 35 – 45 % // Air Pressure: 1005 – 1013 hPa

8.1 Antenna requirement

8.1.1 Regulation

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

8.1.2 Result

Antenna Type	Antenna description	Frequency GHz	Gain dBi	Number of Antennas
Patch Array Antenna	Integrated in IWR6843AOP Single-Chip 60- to 64-GHz mmWave Sensor	**60 – 64**	**18.0**	3
Lense Antenna	HF Lense	**60 – 64**	**2.1**	1

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.***~~

Test setup photos / test results are attached	**Yes**	~~**No**~~	Annexe no.: 5

8.2 AC line conducted limits

8.2.1 Regulation

According to FCC §15.207 (a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Conducted Limits		
Frequency of Emission	**Quasi-Peak (QP)**	**Average (AV)**
MHz	**dBµV**	**dBµV**
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 -30	60	50
*Decreases with the logarithm of the frequency		

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 µV within the frequency band 535–1705 kHz, as measured using a 50 µH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

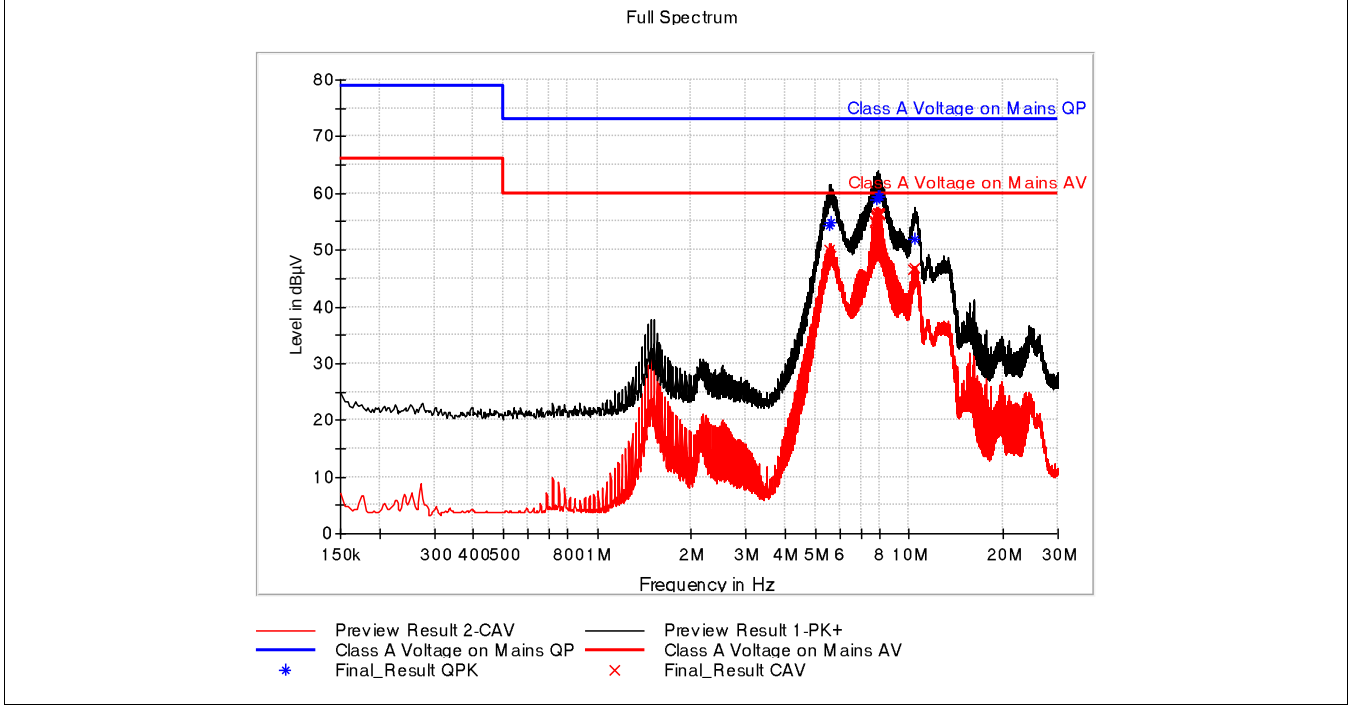
(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

8.2.2 Test procedures

The EUT and the additional equipment (if required) are connected to the main power through a line impedance stabilization network (LISN). The LISN must be appropriate to ANSI C63.10-2013.
Additional equipment must also be connected to a second LISN with the same specifications described in the above section (if required).

8.2.3 Result

Conducted emissions - AC port acc to § 15.107 Rio inside the Host device Marveloc-CURTAIN									
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
5.552250	---	50.07	60.00	9.93	1000.0	9.000	N	GND	10.4
5.554650	54.43	---	73.00	18.57	1000.0	9.000	N	GND	10.4
5.615250	---	48.90	60.00	11.10	1000.0	9.000	N	GND	10.4
5.616050	54.73	---	73.00	18.27	1000.0	9.000	N	GND	10.4
7.759500	---	54.95	60.00	5.05	1000.0	9.000	N	GND	10.5
7.791000	---	55.11	60.00	4.89	1000.0	9.000	N	GND	10.5
7.823950	58.90	---	73.00	14.10	1000.0	9.000	N	GND	10.5
7.824750	---	55.66	60.00	4.34	1000.0	9.000	N	GND	10.5
7.856250	---	56.02	60.00	3.98	1000.0	9.000	N	GND	10.5
7.887750	---	56.32	60.00	3.68	1000.0	9.000	N	GND	10.5
7.919250	---	56.42	60.00	3.58	1000.0	9.000	N	GND	10.5
7.920050	59.50	---	73.00	13.50	1000.0	9.000	N	GND	10.5
7.953000	---	56.41	60.00	3.59	1000.0	9.000	N	GND	10.5
7.984500	---	56.52	60.00	3.48	1000.0	9.000	N	GND	10.5
8.016000	59.28	---	73.00	13.72	1000.0	9.000	N	GND	10.5
8.016000	---	56.44	60.00	3.56	1000.0	9.000	N	GND	10.5
8.047500	---	56.12	60.00	3.88	1000.0	9.000	N	GND	10.5
10.351500	---	46.51	60.00	13.49	1000.0	9.000	L1	GND	10.7
10.383800	51.93	---	73.00	21.07	1000.0	9.000	N	GND	10.7
10.448250	---	46.75	60.00	13.25	1000.0	9.000	L1	GND	10.7
Measurement uncertainty < ± 2 dB									



Test Cables used	---
Test equipment used	414, 418,145 (Equipment TÜV NORD CERT GmbH EMV Services)

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

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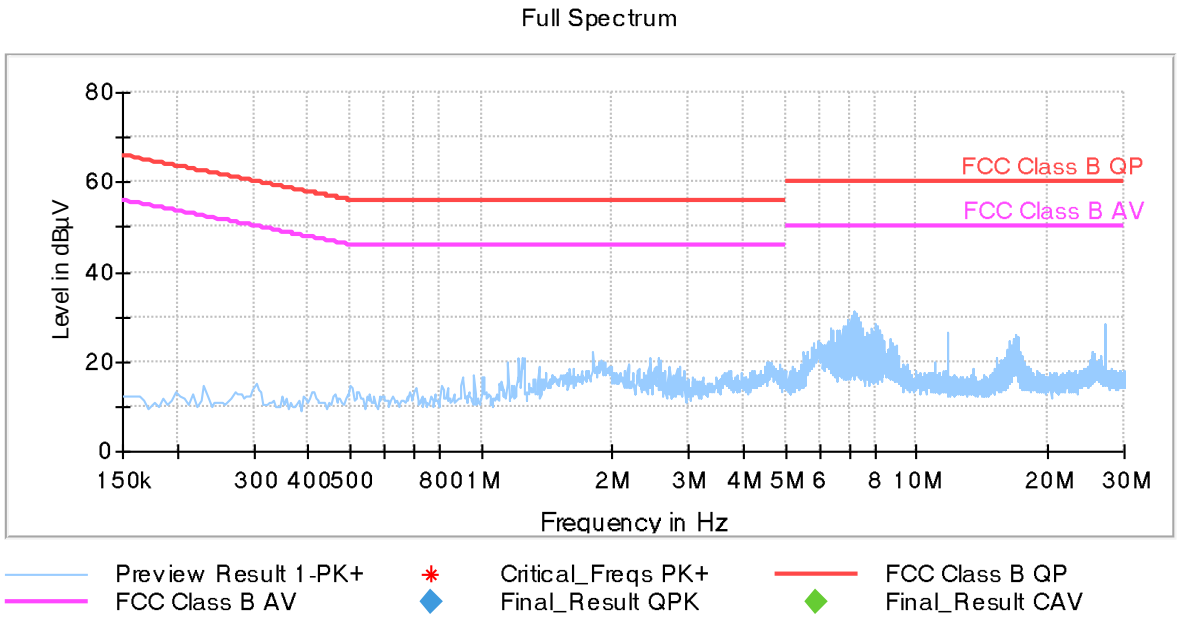
Conducted emissions - AC port acc to § 15.207 **Rio (stand alone) inactive mode**									
Frequency (MHz)	**QuasiPeak (dBµV)**	**CAverage (dBµV)**	**Limit (dBµV)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Line**	**PE**	**Corr. (dB)**
---	---	---	---	---	---	---			---
---	---	---	---	---	---	---			---
---	---	---	---	---	---	---			---
---	---	---	---	---	---	---			---
Measurement uncertainty < ± 2 dB									



Test Cables used	K ISN2
Test equipment used	60, 272, 551, 665

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~[*]

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

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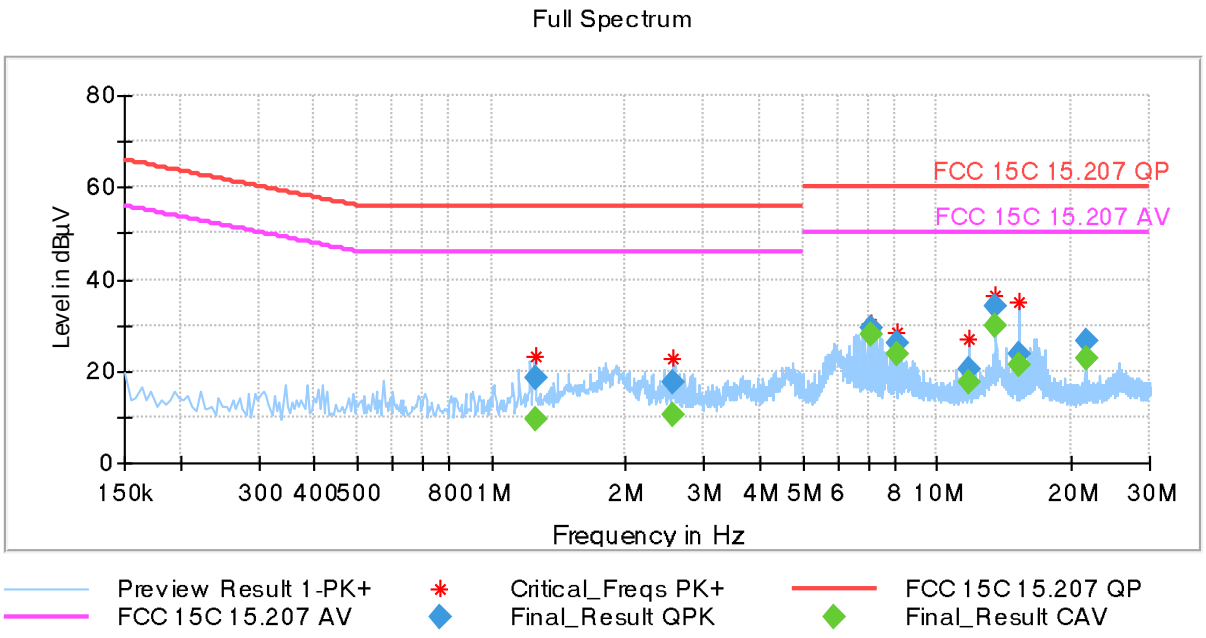
Conducted emissions - AC port acc to § 15.207
Rio (stand alone) active mode (worst case emission)

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
1.252500	---	9.45	46.00	36.55	1000.0	9.000	L1	GND	1.2525
1.252500	18.56	---	56.00	37.44	1000.0	9.000	L1	GND	1.2525
2.557500	---	10.29	46.00	35.71	1000.0	9.000	L1	GND	2.5575
2.557500	17.73	---	56.00	38.27	1000.0	9.000	L1	GND	2.5575
7.098000	---	28.07	50.00	21.93	1000.0	9.000	L1	GND	7.0980
7.098000	29.13	---	60.00	30.87	1000.0	9.000	L1	GND	7.0980
8.142000	---	23.64	50.00	26.36	1000.0	9.000	L1	GND	8.1420
8.142000	26.21	---	60.00	33.79	1000.0	9.000	L1	GND	8.1420
11.782500	---	17.43	50.00	32.57	1000.0	9.000	L1	GND	11.782
11.782500	20.19	---	60.00	39.81	1000.0	9.000	L1	GND	11.782
13.560000	---	29.97	50.00	20.03	1000.0	9.000	L1	GND	13.560
13.560000	33.91	---	60.00	26.09	1000.0	9.000	L1	GND	13.560
15.256500	---	21.36	50.00	28.64	1000.0	9.000	L1	GND	15.256
15.256500	23.61	---	60.00	36.39	1000.0	9.000	L1	GND	15.256
21.529500	---	22.87	50.00	27.13	1000.0	9.000	L1	GND	21.529
21.529500	26.48	---	60.00	33.52	1000.0	9.000	L1	GND	21.529

Measurement uncertainty < ± 2 dB



Test Cables used	K ISN2
Test equipment used	60, 272, 551, 665

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

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8.3 Radiated peak power (EIRP)

8.3.1 Regulation

According to FCC §15.255 (c), within the 57–71 GHz band, emission levels shall not exceed the following EIRP:

(1) Products other than fixed field disturbance sensors and short-range devices for interactive motion sensing shall comply with one of the following emission limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (c)(1)(i) of this section.

(B) The provisions of §15.204(c)(2) and (4) that permits the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provisions. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the systems will be marketed and operated. Compliance testing shall be performed using the highest gain and the and lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in §2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

(2) Field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (b)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed -10 dBm and the peak EIRP level shall not exceed 10 dBm.

(4) The Peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

8.3.2 Test Procedure

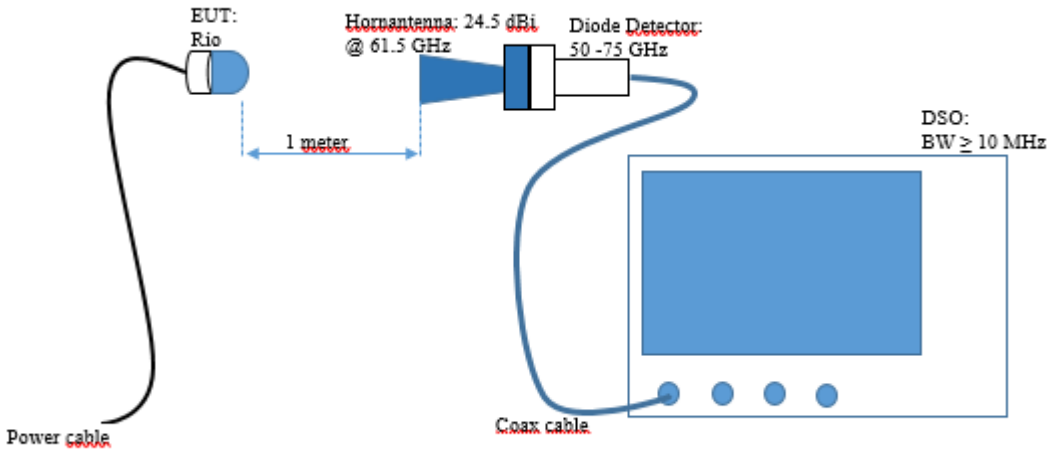
For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2)

Maximum measurement distance for the final radiated measurements above 40 GHz was determined according to ANSI C63.10-2013 section 9.8. To achieve maximum level of emission, maximizing procedure was applied according to ANSI C63.10-2013 section 9.8 where initially an exploratory search for emissions was carried out to determine the approximate direction at which each observed emissions emanates from the EUT. Secondly, for each emission observed a final measurement was executed to find the final position, polarization and orientation at which the maximum level of emission was observed. Measurement of the fundamental emission can be done using an RF detector according to the procedure ANSI C63.10-2013 section 9.11.

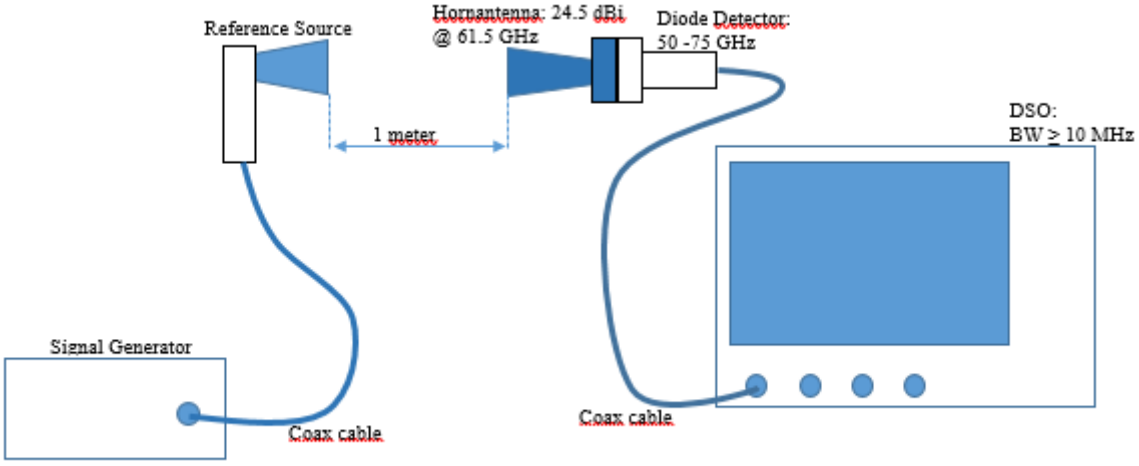
8.3.3 Test setup

Radiated measurements setup (Radiated peak output power)

Measurement of the radiated EUT output level



Measurement of the substituted power level



8.3.4 Result

Test Mode: Transmitting

Radiated peak output power acc. to FCC §15.255 (c)(3)							
f	**Detctor**	**Polar**	**Substituted SG Level**	**Antenna Gain**	**EIRP Power**	**EIRP Limit**	**Margin**
GHz	**Type**	**H/V**	**dBm**	**dBi**	**dBm**	**dBm**	**dB**
60.035	PK	V	**-35.60**	24.5	**8.02**	10.0	**1.98**
61.500	PK	V	**-35.55**	24.5	**8.07**	10.0	**1.83**
63.130	PK	V	**-35.86**	24.5	**7.76**	10.0	**2.24**
Measurement uncertainty: ± 1.5 dB							

Note 1: According to FCC §15.255 (c)(3)
Note 2:The measurement distance is 1.0 m.
Note3: RF Detector and a DSO with a Bandwidth greater than 10 MHz were used to make the Measurements
Note 4: the measurement performed with radiation method, according to ANSI C63.10-2013 Clause 9.11:

$$E = 126.8\text{-}20\log(\lambda) + P - G \qquad EIRP = E_{Meas} + 20\log(d_{meas})\text{-}104.7$$

therefore,

$$EIRP = 126.8\text{-}20\log(\lambda) + P - G + 20\log(d_{meas})\text{-}104.7$$

$$EIRP = 22.1\text{-}20\log(\lambda) + P\text{-}G$$

where,

$\lambda = 300 * 10^6 / f$

λ is the free-space wavelength in m at the frequency of measurement
f is the frequency in Hz

Test Cables used	K168, K169
Test equipment used	222, 384, 511, 571, 617, 681

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	~~Yes~~	**No**	Annex no.:

8.4 Peak conducted output power

8.4.1 Regulation

According to FCC §15.255 (e), except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

(2) Peak transmitter conducted output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and that has a video bandwidth of at least 10 MHz.

(3) For purposes of demonstrating compliance with this paragraph, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.

8.4.2 Test procedure

Refer to ANSI C63.10-2013 Section 9.7 “Equation to calculate conducted output power”

8.4.3 Result

Conducted output power acc. to FCC §15.255 (c)(3)						
Frequency (GHz)	**Peak EIRP Power (dBm)**	**Antenna Gain (dBi)**	**Lens Antenna Gain (dBi)**	**Peak Conducted Power (dBm)**	**Limit (dBm)**	**Margin (dB)**
60.035	8.02	18.0	2.1	**-12.08**	-10	2.08
61.500	8.07	18.0	2.1	**-12.03**	-10	2.03
63.130	7.76	18.0	1.9	**-12.14**	-10	2.14

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	~~Yes~~	**No**	Annex no.:

8.5 Transmitter spurious emission

8.5.1 Regulation

According to FCC §15.255 (d), limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

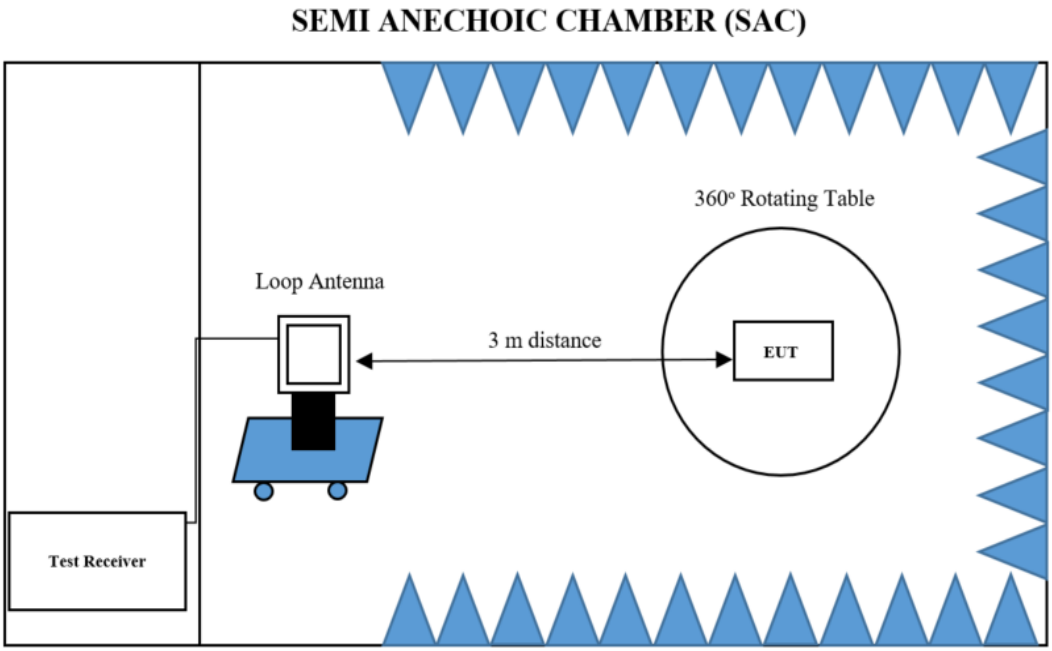
(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

8.5.2 Test setup

Radiated measurements setup (9 kHz – 30 MHz)



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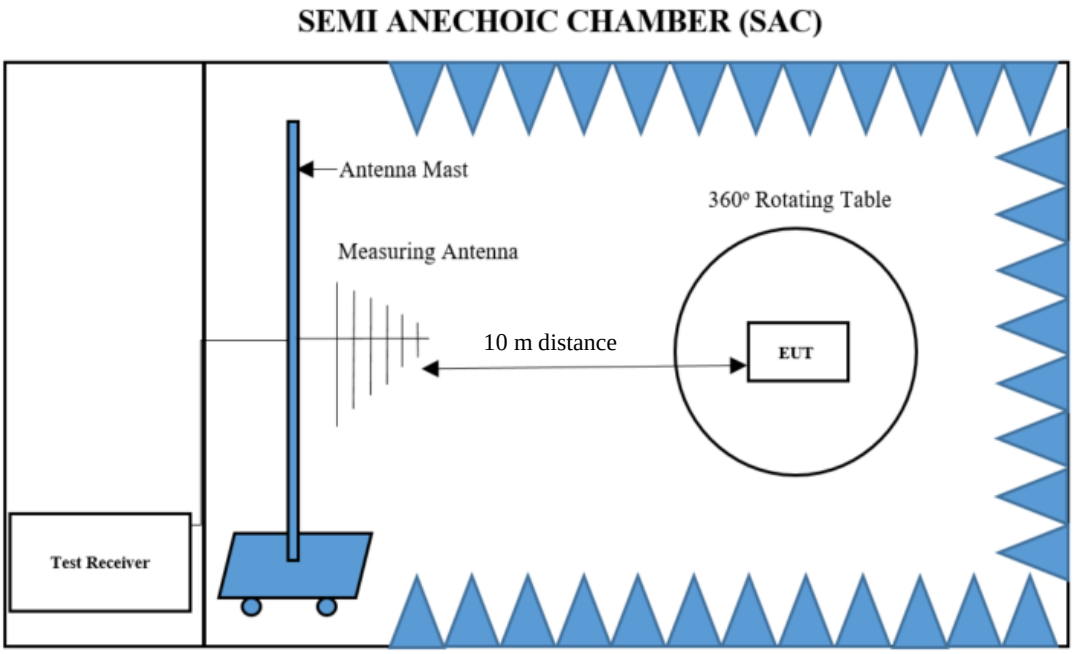
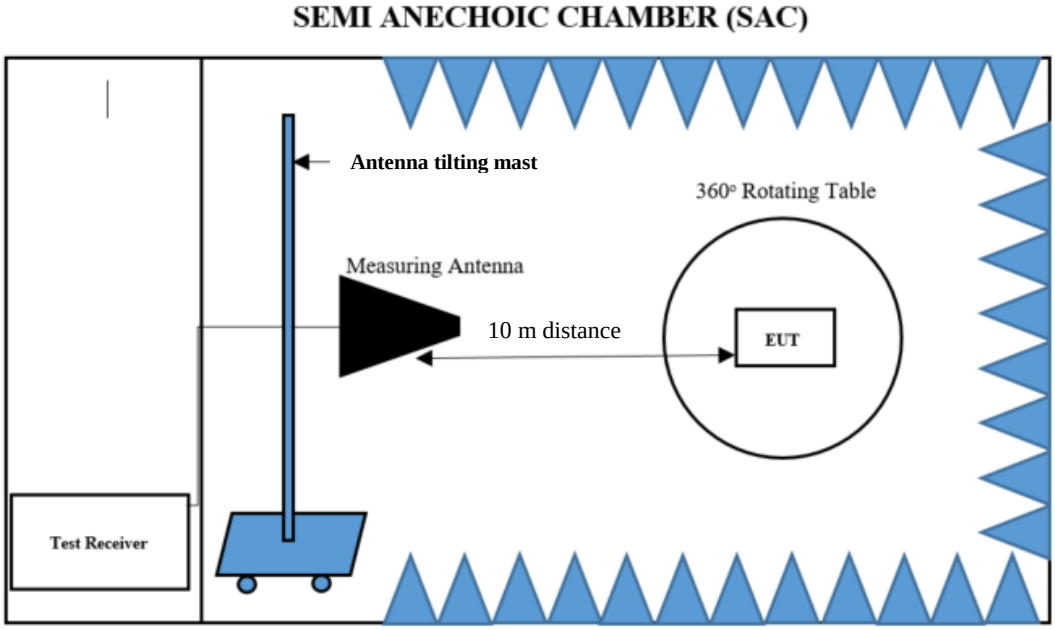
LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany

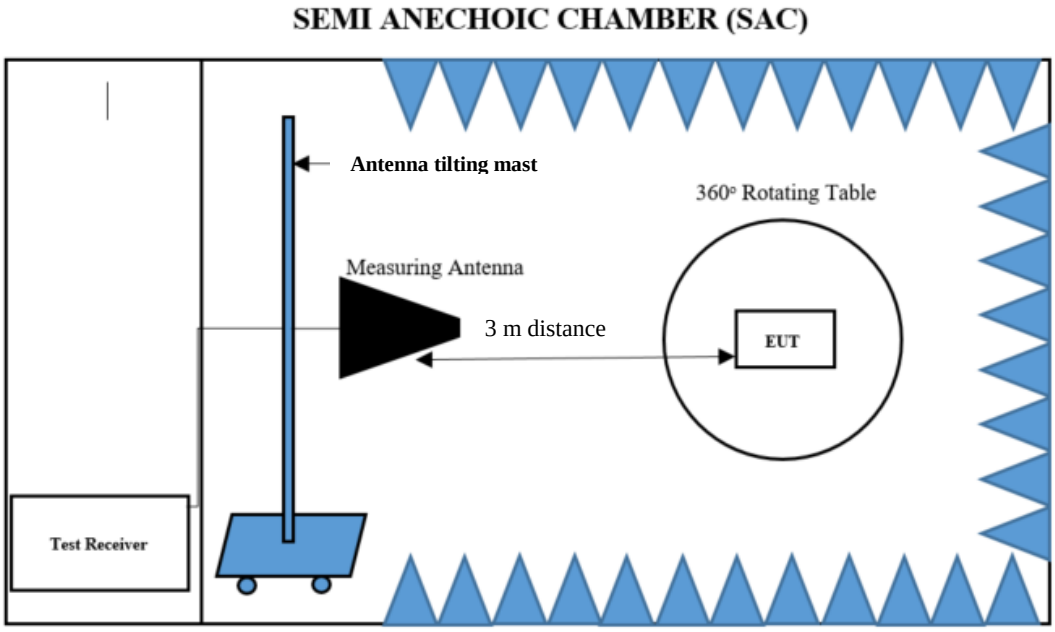
Radiated measurements setup (30 MHz – 1 GHz)



Radiated measurements setup above 1 GHz – 18 GHz



Radiated measurements setup above 18 GHz – 40 GHz



Radiated measurements from 9 kHz – 30 MHz, 30MHz – 1 GHz and 1 GHz – 18 GHz were performed using a small loop antenna, Linear polarized Logarithmic Periodic Broadband Antenna and stacked Logarithmic-Periodic Broadband Antenna for linear polarized respectively with a measuring distance of 3 m inside SAC as shown in the above test setup diagrams. Radiated measurements from 18 GHz – 40 GHz were performed using a horn antenna at a measuring distance of 3 m. Above 40 GHz, the measuring antenna is scanned around the entire perimeter of the EUT in both horizontal and vertical polarization, at the distance of 1.0 m from 40 GHz – 90 GHz and 0.5 m from 90 GHz – 200 GHz.

The radiated emission tests were performed in a 10 meter SAC using the setup accordance with the ANSI C63.10.

8.5.2 Test Procedure

The measurement of harmonic and spurious emissions at or below 40 GHz was performed in accordance with the standard test methods ANSI C63.10-2013 section 6.3 – 6.6. The measurement above 40 GHz was carried out in accordance with the test procedure ANSI C63.10-2013 section 9.12.

In accordance with the FCC subpart A §15.35, frequencies below or equal to 1 GHz, the measurements were done using a quasi-peak detector. For the frequencies from 1 GHz – 40 GHz, all the radiated emission measurements were carried out using a peak and CISPR average detectors. In accordance with the FCC subpart C §15.255, the radiated emission measurements were made using a peak detector.

Radiated emissions test characteristics	
Test distance	10 m, 3 m , 1 m, 0.5 m *
Test instrumentation resolution bandwidth	9 kHz (Below 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (Above 1000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/horizontal

* At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

8.5.3 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:
The receiver reading is 32.7 dBµV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBµV/m.
The 35.91 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm (35.91/20) = 62.44

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f) (1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

8.5.4 Result

Transmitter spurious radiation above 9 kHz – 30 MHz (Section 15.209)									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
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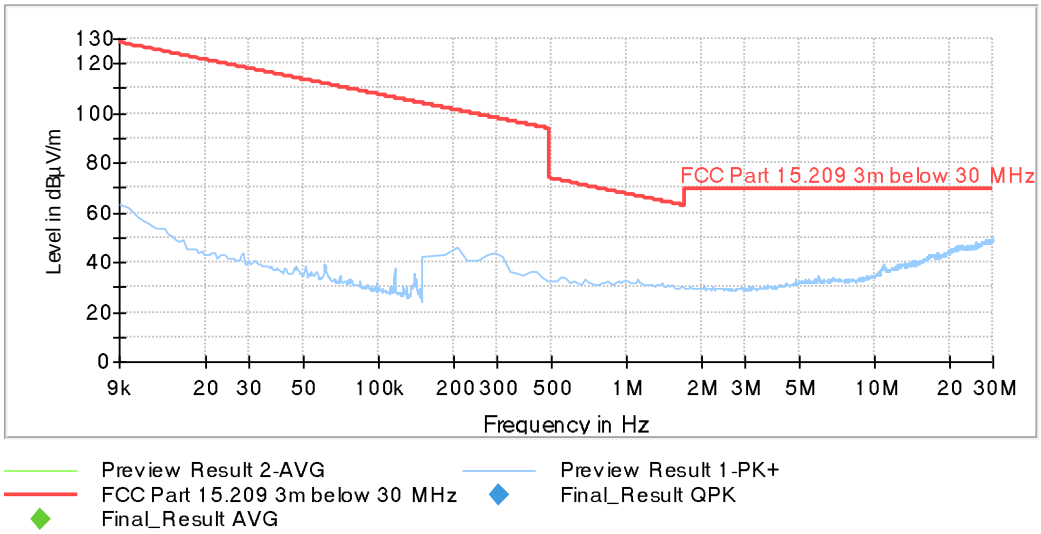
Measurement uncertainty: ± 4 dB									



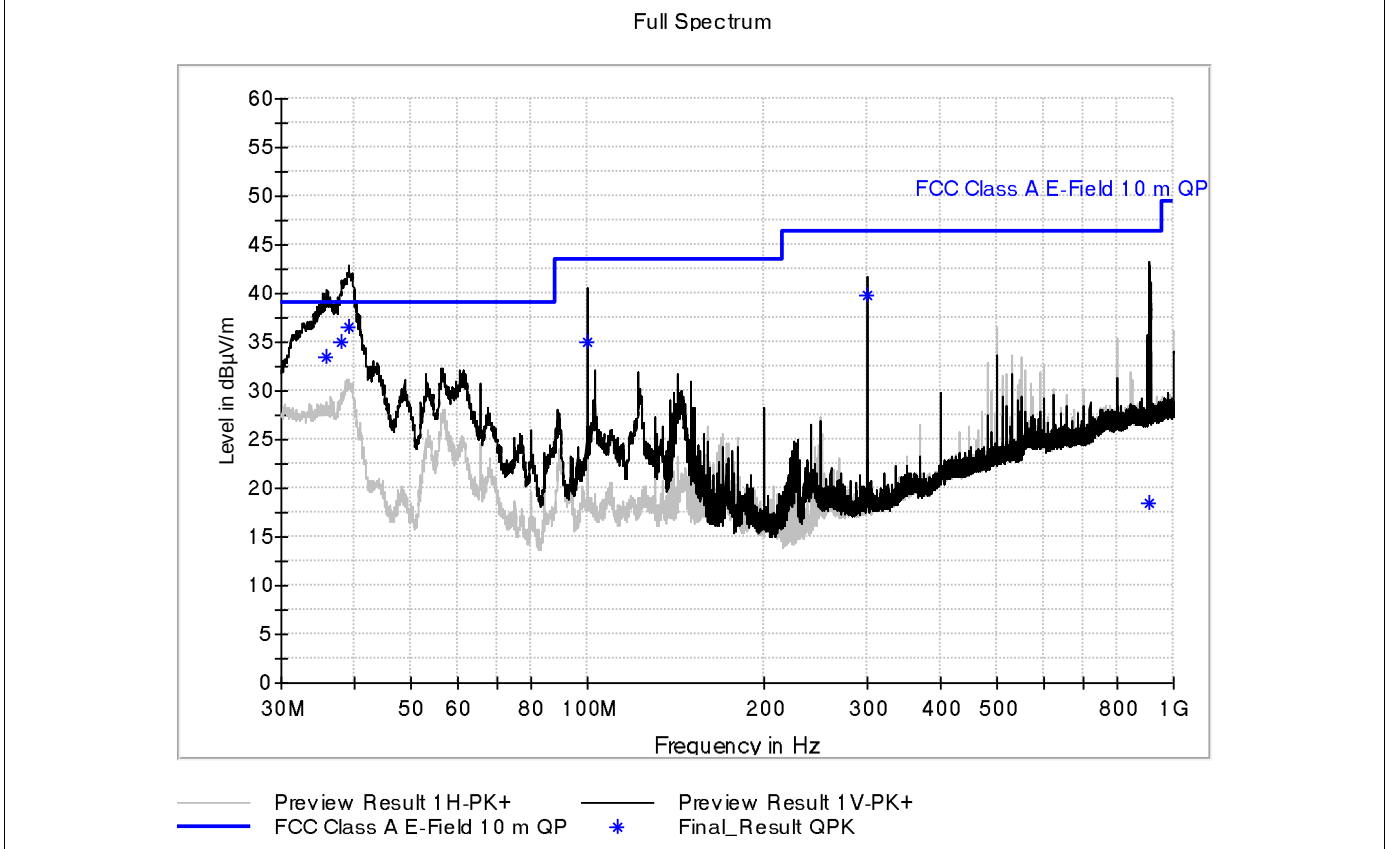
Test Cables used	---
Test equipment used	23, 145 (Equipment TÜV NORD CERT GmbH EMV Services)

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.**~~[*]

Test setup photos / test results are attached	**Yes**	~~**No**~~	Annex no.: 6

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany

Transmitter spurious radiation above 30 MHz – 1 GHz (Section 15.109) Rio inside the Host device Marveloc-CURTAIN									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
35.901000	**33.49**	**39.10**	**5.61**	**1000.0**	**120.000**	**124.0**	**V**	**220.0**	**15.6**
38.037000	**34.99**	**39.10**	**4.11**	**1000.0**	**120.000**	**125.0**	**V**	**231.0**	**14.5**
39.039000	**36.51**	**39.10**	**2.59**	**1000.0**	**120.000**	**100.0**	**V**	**251.0**	**14.0**
99.999000	**35.00**	**43.50**	**8.50**	**1000.0**	**120.000**	**136.0**	**V**	**149.0**	**11.8**
299.997000	**39.73**	**46.40**	**6.67**	**1000.0**	**120.000**	**311.0**	**V**	**138.0**	**14.6**
907.983000	**18.42**	**46.40**	**27.98**	**1000.0**	**120.000**	**300.0**	**V**	**239.0**	**23.4**
Measurement uncertainty: ± 4 dB									



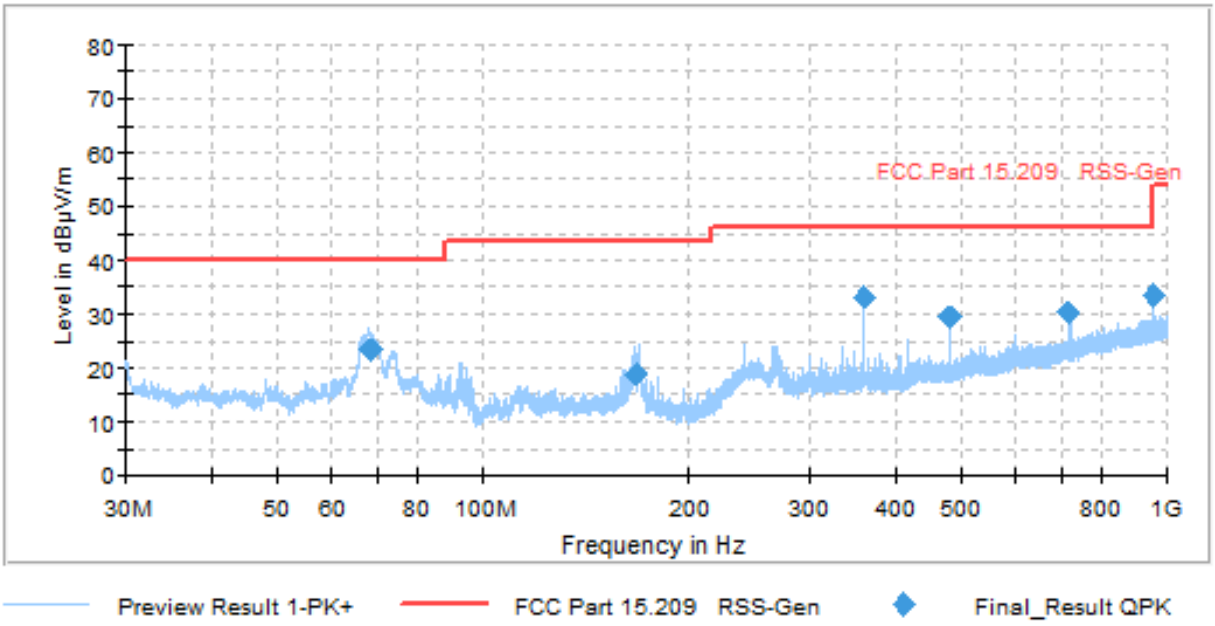
Test Cables used	---
Test equipment used	305, 145 (Equipment TÜV NORD CERT GmbH EMV Services)

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.**~~[*]

Test setup photos / test results are attached	**Yes**	~~**No**~~	Annex no.: 6

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany

Transmitter spurious radiation above 30 MHz – 1 GHz (Section 15.209) Rio (stand alone)									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
68.510000	**23.43**	**40.00**	**16.57**	**1000.0**	**120.000**	**100.0**	**V**	**217.0**	**12.6**
168.010000	**18.60**	**43.50**	**24.90**	**1000.0**	**120.000**	**180.0**	**H**	**224.0**	**14.1**
360.000000	**33.04**	**46.00**	**12.96**	**1000.0**	**120.000**	**100.0**	**H**	**216.0**	**16.2**
479.970000	**29.31**	**46.00**	**16.69**	**1000.0**	**120.000**	**100.0**	**H**	**26.0**	**19.1**
719.970000	**30.22**	**46.00**	**15.78**	**1000.0**	**120.000**	**106.0**	**H**	**341.0**	**23.2**
959.980000	**33.29**	**46.00**	**12.71**	**1000.0**	**120.000**	**100.0**	**H**	**210.0**	**26.5**
Measurement uncertainty: ± 4 dB									



Test Cables used	K60, K101, K119
Test equipment used	406, 445a, 660, 665, 667, 668, 669

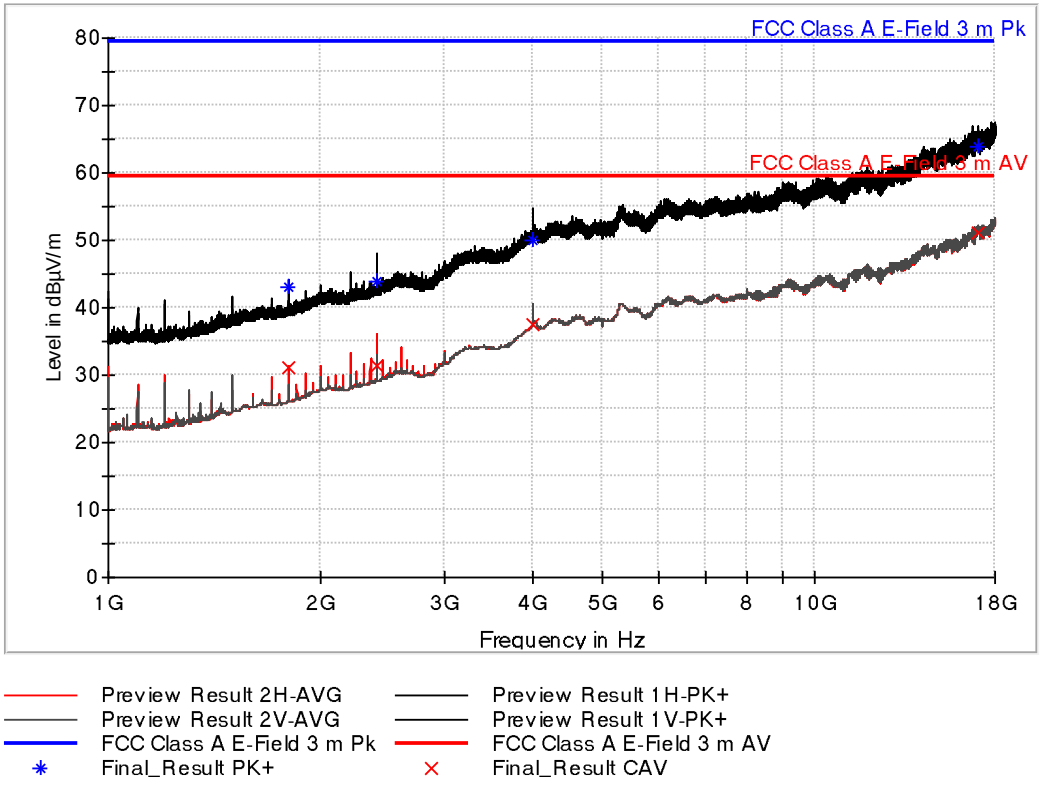
The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.**~~[*]

Test setup photos / test results are attached	**Yes**	~~**No**~~	Annex no.: 6

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany

Transmitter spurious radiation above 1 GHz – 18 GHz (Section 15.109) Rio inside the Host device Marveloc-CURTAIN									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
1799.980000	---	**31.06**	**59.50**	**28.44**	**1000.0**	**1000.000**	**106.0**	**H**	**28.8**
1799.980000	**42.92**	---	**79.50**	**36.58**	**1000.0**	**1000.000**	**106.0**	**H**	**28.8**
2400.030000	**43.78**	---	**79.50**	**35.72**	**1000.0**	**1000.000**	**189.0**	**H**	**31.0**
2400.030000	---	**31.49**	**59.50**	**28.01**	**1000.0**	**1000.000**	**189.0**	**H**	**31.0**
3995.330000	**49.92**	---	**79.50**	**29.58**	**1000.0**	**1000.000**	**100.0**	**H**	**36.1**
3995.330000	---	**37.36**	**59.50**	**22.14**	**1000.0**	**1000.000**	**100.0**	**H**	**36.1**
16997.580000	---	**51.18**	**59.50**	**8.32**	**1000.0**	**1000.000**	**100.0**	**V**	**49.5**
16997.580000	**63.91**	---	**79.50**	**15.59**	**1000.0**	**1000.000**	**100.0**	**V**	**49.5**
Measurement uncertainty: ± 4.9 dB									

Full Spectrum

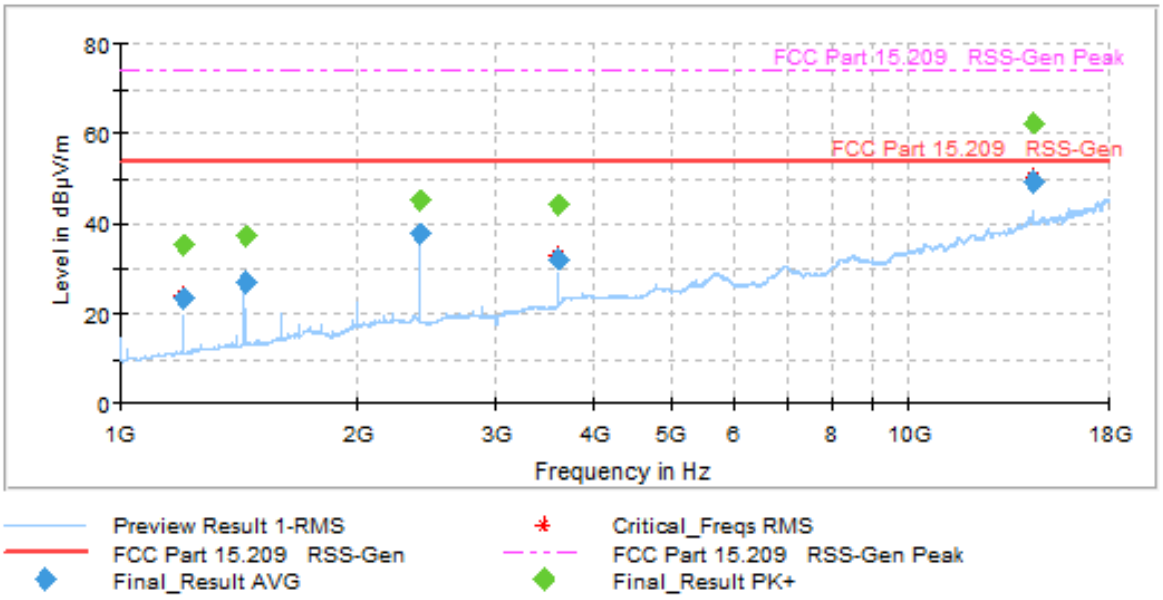


Test Cables used	---
Test equipment used	445a, 145 (Equipment TÜV NORD CERT GmbH EMV Services)

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.***~~

Test setup photos / test results are attached	**Yes**	**No**	Annex no.: 6

Transmitter spurious radiation above 1 GHz – 18 GHz (Section 15.209) Rio (stand alone)										
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**MaxPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
1200.125000	**---**	**35.52**	**74.00**	**38.48**	**1000.0**	**1000.000**	**117.0**	**H**	**1.0**	**25.1**
1200.125000	**23.27**	**---**	**54.00**	**30.73**	**1000.0**	**1000.000**	**117.0**	**H**	**1.0**	**25.1**
1439.875000	**---**	**37.05**	**74.00**	**36.95**	**1000.0**	**1000.000**	**104.0**	**H**	**220.0**	**27.0**
1439.875000	**26.97**	**---**	**54.00**	**27.03**	**1000.0**	**1000.000**	**104.0**	**H**	**220.0**	**27.0**
2399.875000	**37.70**	**---**	**54.00**	**16.30**	**1000.0**	**1000.000**	**136.0**	**H**	**0.0**	**32.3**
2399.875000	**---**	**45.19**	**74.00**	**28.81**	**1000.0**	**1000.000**	**136.0**	**H**	**0.0**	**32.3**
3600.125000	**---**	**44.01**	**74.00**	**29.99**	**1000.0**	**1000.000**	**173.0**	**H**	**1.0**	**25.1**
3600.125000	**32.09**	**---**	**54.00**	**21.91**	**1000.0**	**1000.000**	**173.0**	**H**	**1.0**	**25.1**
14410.625000	**49.35**	**---**	**54.00**	**4.65**	**1000.0**	**1000.000**	**243.0**	**H**	**220.0**	**27.0**
14410.625000	**---**	**62.35**	**74.00**	**11.65**	**1000.0**	**1000.000**	**243.0**	**H**	**220.0**	**27.0**
Measurement uncertainty: ± 4.9 dB										



Test Cables used	K60, K101, K119
Test equipment used	406, 445a, 660, 665, 667, 668, 669

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.***~~

Test setup photos / test results are attached	**Yes**	~~**No**~~	Annex no.: 6

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
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Transmitter spurious radiation above 18 GHz – 40 GHz (Section 15.209)									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
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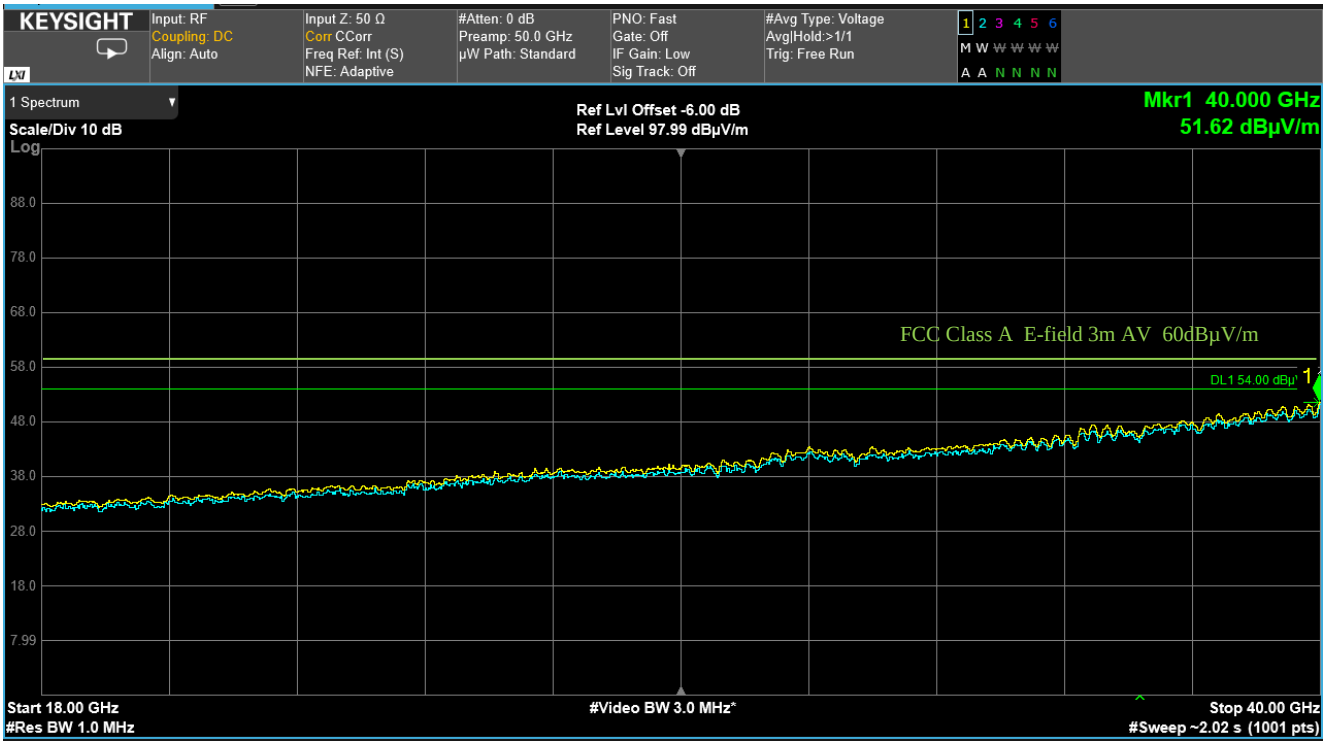
Measurement uncertainty: ± 5.7 dB									



Test Cables used	K147, K167
Test equipment used	223a, 442, 443, 145 (Equipment TÜV NORD CERT GmbH EMV Services)

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

TÜV NORD Hochfrequenztechnik GmbH & Co. KG **Tel.: +49 221 8888950**
LESKANPARK, Gebäude 10, Waltherstr. 49-51, 51069 Köln, Germany

Transmitter spurious radiation above 18 GHz – 40 GHz (Section 15.209) Rio (stand alone)									
Frequency (MHz)	**QuasiPeak (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Meas. Time (ms)**	**Bandwidth (kHz)**	**Height (cm)**	**Pol**	**Azimuth (deg)**	**Corr. (dB/m)**
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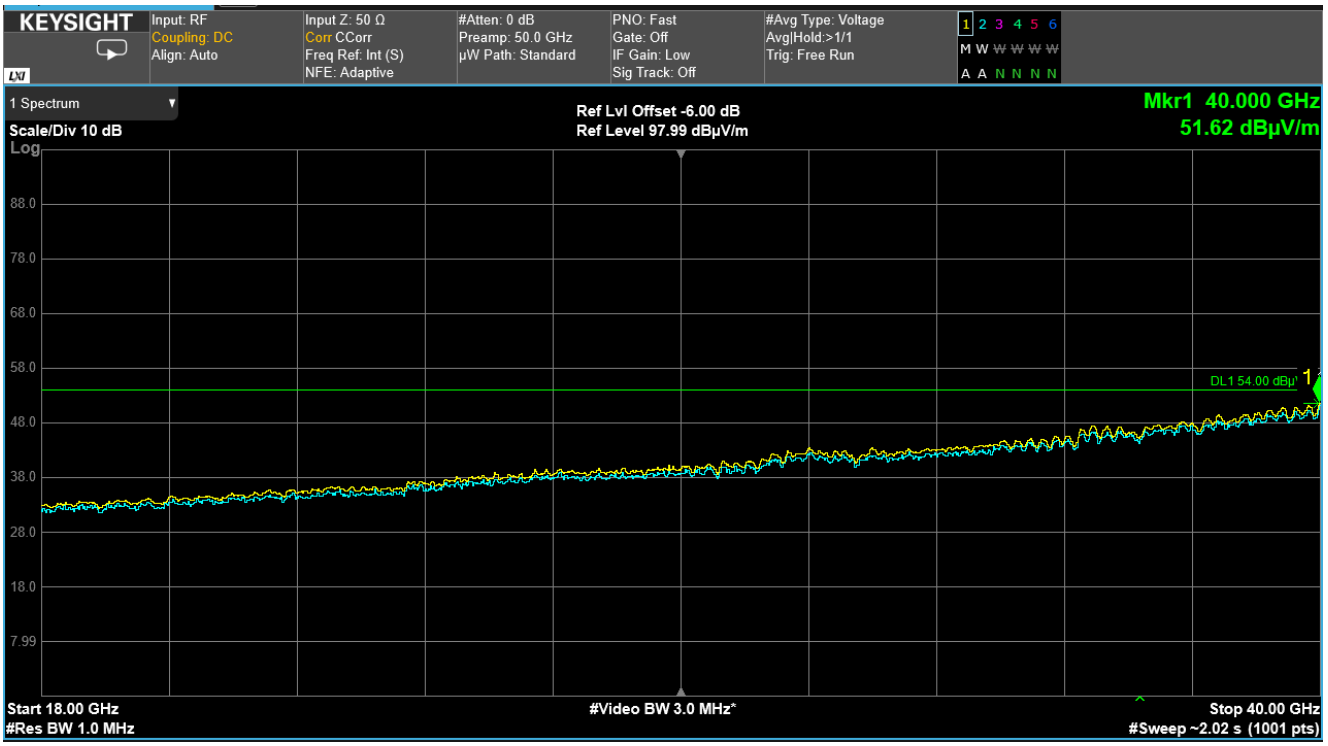
Measurement uncertainty: ± 5.7 dB									



Test Cables used	K147, K167
Test equipment used	223a, 442, 443, 660, 666, 667, 668, 669

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 6

Transmitter spurious radiation above 40 GHz – 200 GHz (FCC § 15.255 section (d)(3))											
Frequency	**Receiver Detector**	**BW**	**Receiver Level**	**Antenna Factor**	**Corrected Level**	**EIRP Calculated**	**Power Density**	**Limit**	**EP**	**Antenna**	
										Pol	**H**
GHz	**Type**	**kHz**	**dBµV**	**dB(1/m)**	**dBµV/m**	**dBm**	**pW/cm²**	**pW/cm²**	**°**	**H / V**	**m**
40.275	Peak	1000	26.94	44.3	71.24	-33.46	**3.97**	90.0	90	V	128
41.259	Peak	1000	29.65	44.3	73.95	-30.75	**7.43**	90.0	90	V	128
42.330	Peak	1000	29.16	44.3	73.46	-31.24	**6.63**	90.0	90	V	128
43.314	Peak	1000	25.47	44.3	69.77	-34.93	**2.83**	90.0	90	V	128
Measurement uncertainty: ± 6.8 dB											
**** All other emissions lower than the noise level of the measuring equipment!**											

Note 1: According to FCC §15.255 (d)(3)
Note 2: The measurement distance is 1.0 m.
Note3: Corrected Amplitude = Meter Reading + Antenna Factor
Note 4: The Mixers and it`s RF cables are calibratet as system, the conversion factor was added into the Spectrum Analyzer.
Note 5:

$$EIRP = E_{Meas} + 20\log(d_{meas}) - 104.7$$

where

EIRP : is the equivalent isotropically radiated power in dBm
E_{Meas} : is the field strength of the emission at the measurement distance in dBµV/m
d_{meas} : is the measurement distance in meter

Note 6:

$$PD = \frac{EIRP_{Linear}}{4\pi d^2}$$

where

PD : is the power density at the distance specified by the limit in W/m²
$EIRP_{Linear}$: is the equivalent isotropically radiated power in Watts
d : is the distance at which the power density limit is specified in meter

Test Cables used	K163, K164
Test equipment used	502, 666, (515+518), (501+549), (545+547), (540+548), (673+348), (674+385)

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8.6 Bandwidth

8.6.1 Regulation

Accroding to FCC § 15.255 (e)(1), Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

According to FCC § 15.255 (f) Frequency stability, fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

8.6.2 Test Procedure

6 dB Bandwidth and Occupied Bandwidth (99 % Bandwidth) were measured. The Occupied Bandwidth was measured directly from the spectrum analyzer's in-built measurement function with correct analyzer settings (RBW, VBW, detector, span and etc). For 6 dB Bandwidth, the measurement settings and procedure were carried out in accordance with the ANSI C63.10-2013 section 9.3. The bandwidth measurements were also performed in extreme environmental conditions.

8.6.3 Result

Measured 99% BW MHz	Measured 6dB BW MHz
3104.1	**3112.0**

Test Cables used	K167
Test equipment used	666, 673

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~ [a]

Test setup photos / test results are attached	**Yes**	~~No~~	Annex no.: 3

8.7 Frequency tolerance

8.7.1 Regulation

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

8.7.2 Test procedures

Stability with respect to ambient temperature:

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. If possible, a dummy load should be connected to the EUT, because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn the EUT on, and tune it to one of the number of frequencies required

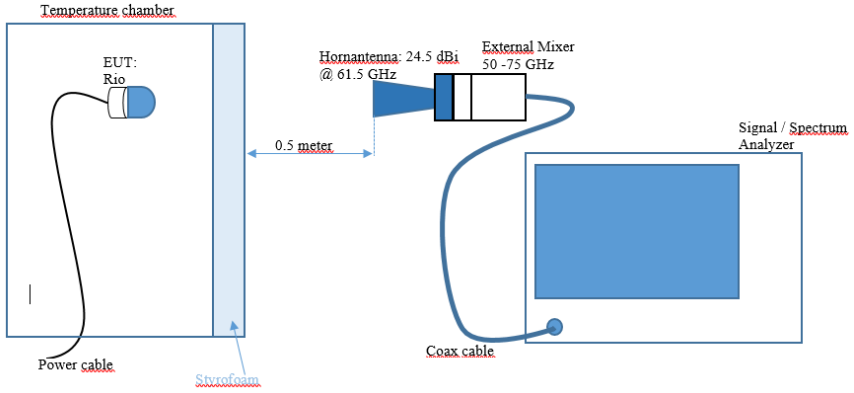
Couple the intentional radiator output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable and placing the measurement antenna near the EUT (e.g., 15 cm away) or by connecting a dummy load to the measuring instrument through an attenuator, if necessary.

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. Turn the EUT on, and couple its output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable.

Adjust the location of the measurement antenna and the controls on the measuring instrument to obtain a suitable signal level (i.e., a level that will not overload the measuring instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

Tune the EUT to any one of the number of frequencies specified. Turn the EUT off, and place it inside an environmental chamber if appropriate. Allow the chamber to stabilize at +20 °C before proceeding. Turn on the EUT, and record the operating frequency of the intentional radiator at startup and two, five, and ten minutes after startup. Turn the EUT off and allow it to cool to the ambient temperature, and then repeat this procedure for the number of the frequencies specified. Four measurements are made at each operating frequency.

8.7.2 Test setup



Stability with respect to input voltage:

Supply the EUT with nominal ac voltage, or install a new or fully charged battery in the EUT. If possible, a dummy load should be connected to the EUT, because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn the EUT on, and tune it to one of the number of frequencies required.

Couple the intentional radiator output to the measuring instrument by connecting an antenna to the measurement instrument with a suitable length of coaxial cable and placing the measurement antenna near the EUT (e.g., 15 cm away) or by connecting a dummy load to the measuring instrument through an attenuator, if necessary.

Adjust the location of the measurement antenna and the controls on the measuring instrument to obtain a suitable signal level (i.e., a level that will not overload the measuring instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Turn the EUT off, and place it inside an environmental temperature chamber. For devices that are normally operated continuously, the EUT may be energized while inside the test chamber. For devices that have oscillator heaters, energize only the heater circuit while the EUT is inside the chamber.

Set the temperature control on the chamber to the highest specified EUT operating temperature, and allow the temperature inside the chamber to stabilize at the set temperature before starting frequency measurements.

While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized. Four measurements in total are made.

Repeat the above procedure until the number of frequencies specified has been measured. After all measurements have been made at the highest specified temperature, turn the EUT off. Repeat the above measurement process for the EUT with the test chamber set at the lowest temperature specified by the regulatory or procuring agency. Measurements shall be made at the number of frequencies specified.

8.7.3 Result

Test conditions	**Frequency tolerance**			
	Frequency (GHz)			
T_{nom} = +20° C	**f_L Measured**	**f_H Measured**	**f_L Limit**	**f_H Limit**
V_{min} = 4.25 V DC	**60.024**	**63.137**	**57.000**	**71.000**
V_{nom} = 5.0 V DC	**60.024**	**63.137**	**57.000**	**71.000**
V_{max} = 5.75 V DC	**60.024**	**63.137**	**57.000**	**71.000**
Measurement uncertainty	± 5*10^{-8}			

Test conditions	**Frequency tolerance**			
	Frequency Measured (GHz)			
V_{nom} = 5 V DC	**f_L Measured**	**f_H Measured**	**f_L Limit**	**f_H Limit**
T_{min} -20 °C	**60.028**	**63.142**	**57.000**	**71.000**
T_{min} -10 °C	**60.027**	**63.142**	**57.000**	**71.000**
T_{min} 0 °C	**60.026**	**63.140**	**57.000**	**71.000**
T_{min} +10 °C	**60.025**	**63.138**	**57.000**	**71.000**
T_{min} +20 °C	**60.024**	**63.137**	**57.000**	**71.000**
T_{min} +30 °C	**60.024**	**63.136**	**57.000**	**71.000**
T_{min} +40 °C	**60.023**	**63.134**	**57.000**	**71.000**
T_{min} +50 °C	**60.018**	**63.132**	**57.000**	**71.000**
Measurement uncertainty	±5*10 $^{-8}$			

Test Cables used	K163
Test equipment used	666, (673+348)

The equipment passed the conducted tests	**Yes**	~~**No**~~	~~**N.t.**~~*

Test setup photos / test results are attached	~~**Yes**~~	**No**	Annex no.:

8.8 RF radiation exposure

8.8.1 Regulation

According to FCC § 15.255 (g), Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note 1: f = frequency in MHz; * = Plane-wave equivalent power density
Note 2: RF exposure calculation according to §1.1310 and §2.1091

8.8.2 Result

These equations are generally accurate in the far field of an antenna but will over predict power density in the near field, where they could be used for making a “worst case” prediction.

$S = PG/4\pi R^2$

where S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units e.g. mW)
G = power gain of the antenna in the direction of interest relative to the isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units e.g. cm)

OR, $S = EIRP/(4\pi R^2)$

where, EIRP = equivalent isotropically radiated power

Operating Frequency	**EIRP**		**Power density (S) @ 20 cm**	
			Calculated	**Limit**
GHz	**dBm**	**mW**	**mW/cm^2**	
60.035	**8.0**	**6.31**	**0.0013**	**1.0**
61.500	**8.0**	**6.31**	**0.0013**	**1.0**
63.130	**7.8**	**6.03**	**0.0012**	**1.0**

The equipment passed the conducted tests	**Yes**	~~No~~	~~N.t.~~*

Test setup photos / test results are attached	~~Yes~~	**No**	

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§15.255(a) (h) OPERATION RESTRICTION AND GROUP INSTALLATION

§15.255 (a)
(a) Operation under the provisions of this section is not permitted for the following products:

(1) Equipment used on satellites.

(2) Field disturbance sensors, including vehicle radar systems, unless the field disturbance sensors are employed for fixed operation, or used as short-range devices for interactive motion sensing. For the purposes of this section, the reference to fixed operation includes field disturbance sensors installed in fixed equipment, even if the sensor itself moves within the equipment.

(b) Operation on aircraft is permitted under the following conditions:

(1) When the aircraft is on the ground.

(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:

(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.

(ii) Equipment shall not be used on aircraft where there is little attenuation of RF signals by the body/fuselage of the aircraft. These aircraft include, but are not limited to, toy/model aircraft, unmanned aircraft, crop-spraying aircraft, aerostats, etc.

§15.255 (g)
(h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

Result of Operation Restriction

EUT is a The Marveloc-CURTAIN is a millimeter wave (or M-Ray) based measurement system by Hammer- IMS. Millimeter waves for Industrial sectors are favored in situations where conventional technologies such as optical technologies, nuclear or radioactive radiation, ultrasound waves, inductive or capacitive measurement systems fail, are undesirable or provide an unreliable output. The integrated robust M-Ray technology is clean and safe. The Marveloc-CURTAIN is a machinewide scanning solution providing near 100 percent coverage of a produced material for a variable range of materials: nonwovens (needlepunching, bonding, tufting, etc.), textiles (lamination, coating, etc.), physical and chemical foaming processes, plastic films and sheets.. The Manufacturer declared that the EUT will not be advertised or sold for use on aircraft or satellites.

Result of Group installation

The frequency, amplitude and phase of the transmit sign al are set within the EUT. There are no external phase-locking inputs or any other means of combining two or more units together to realize a beam-forming array

9. Additional information to the test report

Remarks	Description
N.t.[1]	Not tested, because the antenna is part of the PCB
N.t.[2]	Not tested, because the EUT is directly battery powered
N.t.[3]	Not tested, because not applicable to the EUT
N.t.[4]	Not tested, because not ordered

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10. List of test equipment

State Sept.08, 2021					
Marking	**Manufacturer**	**SW/Type/Serial-No.**	**Last Cal./Val.**	**Next Cal./Val.**	**No.**
1 Measuring Instruments					
Attenuator	Radiall	---	*Nov 19*	*Nov 22*	*62*
Attenuator 3dB	Suhner	6803/17	*Nov 19*	*Nov 22*	*137*
Attenuator 3dB / 18 GHz	Suhner	3dB/18GHz	*Nov 19*	*Nov 22*	*299*
Terminator	Texcan	---	*Nov 19*	*Nov 22*	*304*
Attenuator 6dB / 18 GHz	Suhner	6dB/18GHz	*Nov 19*	*Nov 22*	*344*
Attenuator 20dB / 20GHz	Parzich	40AH-20	*Nov 19*	*Nov 22*	*354*
Terminator	KDI	T173CS	*Nov 19*	*Nov 22*	*490*
Variable transformer	RFT	LS 002	---	---	*154a*
Variable transformer	Schunt+Ben	---	---	---	*155*
Power sensor	Marconi	6914	*Sep 20*	*Sep 22*	*258*
Power sensor	Rohde & Schwarz	NRP18SN	*Nov 19*	*Nov 21*	*651*
3-Path Diode Power Sensor 10 MHz to 8 GHz	Rohde & Schwarz	NRP8S	*Oct 20*	*Oct 22*	*663*
3-Path Diode Power Sensor 10 MHz to 18 GHz	Rohde & Schwarz	NRP18S-20	*Oct 20*	*Oct 22*	*664*
Coaxial Directional Coupler	Narda	3003-20	*Jan 21*	*Jan 24*	*370/342*
Coaxial directional coupler	Mini Circuits	ZFDC-20-5	*Mar 20*	*Mar 22*	*434*
Coaxial directional coupler	Narda+Suhner	---	*Mar 20*	*Mar 23*	*472/492*
Coaxial High Pass Filter	Mini circuits	NHP-700	*Apr 21*	*Apr 24*	*435*
Coaxial High Pass Filter	Mini circuits	NHP-200	*Apr 21*	*Apr 24*	*405*
Coaxial High Pass Filter	Mini circuits	NHP-25+	*Apr 21*	*Apr 24*	*455*
High Pass Filter	Mini circuits	VHF-3500+	*Apr 21*	*Apr 24*	*451*
High Pass Filter	Mini circuits	VHF-1200+	*Apr 21*	*Apr 24*	*452*
Bandpass Filter	Schomandl	BN86871	*Nov 18*	*Nov 21*	*66*
Bandpass Filter	Schomandl	BN68673	*Nov 18*	*Nov 21*	*67*
Low Pass Filter	Mini circuits	SLP550	*Apr 21*	*Apr 24*	*273*
Low Pass Filter	Mini circuits	SLP550	*Apr 21*	*Apr 24*	*274*
RF Current Probe 9 kHz – 30 MHz	Rohde & Schwarz	ESH2-Z1	*Aug 21*	*Aug 24*	*42*
Passive Test Probe – 9 kHz – 30 MHz	TÜV NORD	VDE 0876	*Apr 21*	*Apr 24*	*45*
Coaxial Fixed Attenuator DC – 1 GHz	Texscan	HFP50/10	*Jul 20*	*Jul 23*	*60*
8 Wire Impedance Stabilisation Network	Schwarzbeck	CAT5 8158	*Nov 19*	*Nov 21*	*71a*
RF Current Injection Clamp 0.15 – 1GHz	Lüthi GmbH	EM 101	*Nov 19*	*Nov 22*	*156*
Absorbing Clamp MDS 30MHz – 1GHz	Lüthi GmbH	MDS-21	*Nov 19*	*Nov 22*	*160*
Insertion Unit	Rohde & Schwarz	URV5-Z4	*Mai 19*	*Mai 22*	*162*
Coaxial RF Termination - 0 – 1000 MHz	Telewave Inc.	TWL 35	*Nov 18*	*Nov 21*	*164*
Coaxial RF Termination - 0 – 1000 MHz	Telewave Inc.	TWL 60	*Nov 18*	*Nov 21*	*165*
Fixed Attenuator - DC – 1.5GHz	Bird	Mod/ 8343-060	*Apr. 20*	*Apr. 23*	*177*
Rotary Step Attenuator DC – 2 GHz	Texscan	TA – 50	*Mar20*	*Mar 22*	*184*
CDN up to 230 MHz	MEB	KEN-M 2 /M 3	*Nov 19*	*Nov 21*	*264*
Impulse limiter 10 dB	Rohde & Schwarz	ESH3 Z2	*Mai 19*	*Mai 22*	*272*
Fixed Attenuator - DC – 18 GHz | 30 dB	MTS	---	*Nov 20*	*Nov 23*	*275*
Fixed Attenuator - DC – 18 GHz | 30 dB	MTS	---	*Mar 20*	*Mar 22*	*276*
Passive Probe - 9 kHz – 30 MHz | 2.5 kΩ	RFT	TK 121	*Jun 20*	*Jun 23*	*302*
Passive probe 1.5kΩ	Schwarzbeck	TK 9416	*Oct 20*	*Oct 23*	*621*
Termination Resistor 50 W	Radiall	404011	*Nov 18*	*Nov 21*	*309*
Branching device (4x) 50W	Rohde & Schwarz	892228/20	*Sep 19*	*Sep 22*	*320*
Dummy-Load - 2 – 18 GHz	Narda	MODEL 367NF	*Nov 19*	*Nov 22*	*343*
DC Block Adapter - 0.045 – 26.5 GHz	Hewlett-Packard	11742A	*Apr 21*	*Apr 24*	*356*
Insertion Unit 10V | 9 kHz 1000 MHz	Rohde & Schwarz	URV 5-Z2	*Mai 19*	*Mai 22*	*367*

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RF Probe 0.02 – 1000 MHz	Rohde & Schwarz	395.2680.02	*Mai 19*	*Mai 22*	*368*
150W attenuator	Weinschel	49-20-33	*Oct 19*	*Oct 22*	*374*
Fixed Coaxial Attenuator - DC – 18 GHz	Weinschel	23-6-34	*Feb 20*	*Feb 23*	*375*
Insertion Unit 9 kHz – 2000 MHz	Rohde & Schwarz	URY-Z2	*Oct 19*	*Oct 22*	*416*
Panoramic Adapter (Monitoring)	Schwarzbeck	PAN1550	---	---	*429*
Terminating resistor 50Ω SMA	---	---	*Nov 19*	*Nov 22*	*493*
Terminating resistor 50Ω SMA	---	SC 60-601-0000-31	*Nov 19*	*Nov 22*	*497*
Fixed Attenuator –0 – 40 GHz	Anritsu	41KC-10	*Nov 19*	*Nov 22*	*504*
Fixed Attenuator – 0 – 40 GHz	Anritsu	41KC-10	*Nov 19*	*Nov 22*	*505*
Fixed Attenuator – 0 – 40 GHz	Anritsu	41KC-6	*Nov 19*	*Nov 22*	*506*
Fixed Attenuator – 0 – 40 GHz	Anritsu	41KC-3	*Nov 19*	*Nov 22*	*507*
Electric Dummy Load	RA-NAV Lab.	DA-75U	---	---	*526*
Power Splitter / Combiner	Mini Circuits	ZESC-2-11	*Nov 19*	*Nov 22*	*527*
3 Way Power Splitter / Combiner	Mini Circuits	ZFSC-3-1	*Mar 20*	*Mar 23*	*529*
3 Way Power Splitter / Combiner	Mini Circuits	ZFSC-3-1	*Mar 20*	*Mar 23*	*530*
RF-Attenuator - 6 dB	Haefely	---	*Mar 20*	*Mar 23*	*540*
RF-Attenuator - 1– 120 MHz | 12 dB	Haefely	---	*Mar 20*	*Mar 23*	*541*
RF-Attenuator - 1– 120 MHz | 39 dB	Haefely	---	*Mar 20*	*Mar 23*	*542*
LISN 9kHz – 30 MHz	Schwarzbeck	NNLA 8120	*Aug 20*	*Aug 22*	*551*
HV Probe P6013A	Tektronix	P6013A	*Mai 19*	*Mai 22*	*559*
VLISN 5µH	Schwarzbeck	8125-1944	*Nov 19*	*Nov 21*	*585*
VLISN 5µH	Schwarzbeck	8125-1945	*Nov 19*	*Nov 21*	*586*
20dB Attenuator, up to 18 GHz	Mini Circuit	BW-N20W5+	*Nov 19*	*Nov 22*	*594*
Step Attenuator - DC-18 GHz | 0 to 11 dB	Hewlett-Packard	8494B	*Nov 19*	*Nov 22*	*604*
Analyser Reference System	Spitzenberger & Spies	ARS 16/1	*Jan 20*	*Jan 22*	*606a/b/c*
Capacitive Coupling Clamp 5 kV	Schlöder	SFT 415	*Mai 20*	*Mai 23*	*608*
RF Probes for 50 Ω Receivers	Schwarzbeck	TK 9416	---	---	*612*
Diode Detector	Millitech	DET15	*Apr 20*	*Apr 22*	*617*
Current probe TRMS	BEHA APROB	CHB35	*Oct 19*	*Oct 22*	*652*
Semi Anechoic Chamber	COMTEST	SAC-3m	*Apr 21*	*Apr 23*	*660*
Maturo Turntable	Maturo	TT2.0SI (SN: TT2.05SI/817 SW: 1.0.0.4473)	---	---	*667*
Maturo Antenna Mast	Maturo	TAM4.5-E-10kg (SN: 10011/216/2588.01)	---	---	*668*
Maturo Controller	Maturo	FCU3.0/009/2588.01 (SN: 10014/2019)	---	---	*669*
Current probe 20 Hz – 100 MHz	Rohde & Schwarz	EZ-17 (0816.2063.03)	*Mar 20*	*Mar 23*	*670*
Coupling Decoupling Network	AMETEK	CDN ST08A	*Aug 20*	*Aug 23*	*762*
BONN HF Switch Matrix DC – 8 GHz	BONN Elektronik	BAS 0080-3	---	---	*682*
External Directional Coupler	BONN Elektronik	BDC 1060-40/500	*Dec 20*	*Dec 22*	*683*
BI-Directional Coax. Coup. 50-1000 MHz	Narda	3020A	*Jan 18*	*Jan 22*	*141*
Vertical coupling plate	TÜV NORD HFT	---	---	---	*265*
Measuring table	TÜV NORD HFT	---	---	---	*106*
Data line coupling network	EM Test AG	CNV 504/ 508	---	---	285
2 Generators					
EFT/Burst Generator	Schlöder	SFT 1400	*Mai 20*	*Mai 22*	*46a*
Hybrid Generator	Schlöder	CWG1500	*Nov 19*	*Nov 21*	*522*
ESD Generator	Schlöder	SESD 216	*Oct 19*	*Oct 21*	*653*
Signal Generator	Rohde & Schwarz	SMB100A	*Jul 20*	*Jul 22*	*571*
RF Generator	Rohde & Schwarz	SGT100A	*Apr 20*	*Apr 22*	*636*
Signal Generator	Rohde & Schwarz	SMG	*Jun 21*	*Jun 23*	*136*
Signal Generator	Marconi	2042	*Mai 20*	*Mai 22*	*6*

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Signal Generator	Marconi	2024	*Mai 20*	*Mai 22*	*213*
Puls Generator	EM Test	MPG 200	*Cal. before use*	*Cal. before use*	*181*
Surge Generator	H+H	MIG063 IN S-T	*Apr 21*	*Apr 23*	*561*
3. Antennas					
Loop Ant. 9kHz-30MHz	Schwarzbeck	FMZB1516	*Sep 19*	*Sep 21*	*23*
Biconical Ant. 30-300 MHz	Schwarzbeck	VHA9103/BBA9106	*Apr 20*	*Apr 22*	*80/616*
Double Ridged Horn	Schwarzbeck	BBHA9120C	*Oct 19*	*Oct 21*	*169*
Double Ridged Horn	Schwarzbeck	BBHA 9120A	*Apr 20*	*Apr 22*	*284*
Tri-Log Broadband	Schwarzbeck	VULB9168	*Mai 21*	*Mai 23*	*406*
Broadband Horn 14-40 GHz	Schwarzbeck	BBHA9170	*Nov 19*	*Nov 21*	*442*
Log Per Antenna 0.7-20 GHz	Schwarzbeck	STLP9148	*Mai 21*	*Mai 23*	*445a*
Bilog Ant.	Schwarzbeck	CBL6111	*Cal. before use*	*Cal. before use*	*167*
Balun with biconical BBA9106 (TX)	Schwarzbeck [only for NSA]	VHBB9124	*Nov 19*	*Nov 21*	*0796*
Balun with biconical BBA9106 (RX)	Schwarzbeck [only for NSA]	VHBA9123	*Nov 19*	*Nov 21*	*9758*
Log periodic Ant (TX)	Schwarzbeck [only for NSA]	UHALP9108	*Nov 19*	*Nov 21*	*9002*
Log periodic Ant (RX)	Schwarzbeck [only for NSA]	UHALP9108	*Nov 19*	*Nov 21*	*9003*
Spectrum analyser Mixer 220 – 325 GHz	Radiometer Physics	SAM325	*Aug 21*	*Aug 23*	*591*
Dual Mode Potter Horn 220-325 GHz	Radiometer Physics	325-WR2	---	---	*592*
Dual Mode Potter Horn 75-110 GHz	Radiometer Physics	---	---	---	*649*
Gain Horn Antenna 50-75 GHz	Dorado	GH-15-20	---	---	*511*
Standard Gain Horn 1.7 – 2.6 GHz	Narda	645	---	---	*514*
W-band active Sextupler with input drive amplifier	Spacek Labs Inc.	AW-6XW-0	---	---	*221a*
60 to 65 GHz active frequency quadrupler	Spacek Labs Inc.	A625-4XW-0	---	---	*222a*
Harmonic Mixer 40-60 GHz	Rohde & Schwarz	FS-Z60	*Aug 21*	*Aug 23*	*515*
Gain Horn Antenna 40-60 GHz	Dorado	GH-19-20	---	---	*518*
Spectrum analyser Mixer 90-140 GHz	Radiometer Physics	SAM140	*Aug 21*	*Aug 23*	*545*
Dual Mode Potter Horn 90-140 GHz	Radiometer Physics	140-WR8	---	---	*547*
Spectrum analyser Mixer 140-220GHz	Radiometer Physics	SAM220	*Aug 21*	*Aug 23*	*450*
Dual Mode Potter Horn 140-220 GHz	Radiometer Physics	220-WR5.1	---	---	*548*
Harmonic Mixer 60-90 GHz	Rohde & Schwarz	FS-Z90	*Aug 21*	*Aug 23*	*501*
Dual Mode Potter Horn 60-90 GHz	Radiometer Physics	90-W12	---	---	*549*
Gain Horn 33-55 GHz	Dorado	---	---	---	*383*
Gain Horn 50-75 GHz	Dorado	---	---	---	*384*
Gain Horn 75-110 GHz	Dorado	---	---	---	*385*
Standard Gain Ant. 26.5-40 GHz	Maury Microwave	U211C	---	---	*532/628*
Waveguide Harmonic Mixer 50 – 75 GHz	Keysight	M1971V	*Oct 19*	*Oct 21*	*763*
Waveguide Harmonic Mixer 75 – 110 GHz	Keysight	M1971W	*Oct 19*	*Oct 21*	*764*
Stacked Log.-Per. Antenna 70 MHz – 10 GHz	Schwarzbeck	STLP 9129	---	---	*662*
4. Amplifier					
RF-Power Amplifier 250 kHz – 150 MHz	ENI	3100LA	---	---	---
RF pre-amplifier 100kHz-1.3GHz	HP	8447E	*Aug 20*	*Aug 22*	*166a*
Mitteq amplifier 26.5-40 GHz	Mitteq	---	*Mar 20*	*Mar 22*	*223a*
RF pre-amplifier 1-18GHz	Narda	---	*Mar 20*	*Mar 22*	*345*
Mitteq Amplifier 18-26GHz	Mitteq	---	*Apr 20*	*Apr 22*	*433*
Microwave amplifier 12-18GHz	Schwarzbeck	BBV9719	*Mar 20*	*Mar 22*	*443*
Microwave amplifier 0.5-18GHz	Schwarzbeck	BBV9718	*Apr 21*	*Apr 23*	*444*
RF-Power Amplifier 10kHz-1000 MHz	Poetschke	8100 (Band 1) BHED (Band 2) BHED (Band 3)	---	---	*684*
RF-Power Amplifier 800 MHz – 4,2 GHz	Amplifier Research	10S1G4	---	---	*685*

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RF-Power Amplifier 4 GHz – 8 GHz	Amplifier Research	35S4G8A	---	---	*686*
5. Power supplies					
Programmable Power Supply	Fluke	PM 2813	---	---	*28a*
Power Supply	HP	---	---	---	*125*
Power Supply	Sorensen	LM 30-6	---	---	*134a*
Power Supply	HP	6034L	---	---	*226*
Regulated Power Supply	Farnell	AP60-50	---	---	*408*
Power Supply	EA	PSI 8080-40-DT	---	---	*560*
Power Supply	HP	6032A	---	---	*644*
6. Meters					
Microwave Frequency Counter	Hewlett-Packard	5351B	*Nov 20*	*Nov 22*	*432*
Temperature test cabinet	Heraeus Vötsch	VMT04/35	---	---	*102a*
Temperature test cabinet	Brabender	TTE 32/40 H	---	---	*87*
Digital-Hygro-Thermometer	Greisinger	GFTH95	*Nov 19*	*Nov 21*	*57a*
Volt & RF Power Meter	Rohde & Schwarz	URV35	*Cal. before use*	*Cal. before use*	*161*
Spectrum Analyzer - 9 kHz – 18 GHz	Rohde & Schwarz	FSL18	*Jul 20*	*Jul 22*	*171a*
Multimeter	Gossen Metrawatt	Metrahit pro	*Nov 19*	*Nov 21*	*215a*
Humidity/Temperature Measuring device	TESTO	Testo 625	*Oct 19*	*Oct 21*	*259a*
Volt & RF Power Meter	Rohde & Schwarz	URV35	*Nov 19*	*Nov 21*	*271*
Multimeter	Gossen Metrawatt	Metrahit 26S	*Sep 20*	*Sep 22*	*313*
Level and Power Meter - 9 kHz – 3 GHz	Rohde & Schwarz	URY	*Mar 20*	*Mar 22*	*307*
Temperature test device	Ahlhorn	Almemo 2390-5 PT100	*Mar 20*	*Mar 23*	*401/402*
Digital-Vacuum-/Barometer	Greisinger	GDH12AN	*Oct 19*	*Oct 21*	*558*
Digital Storage Oscilloscope	Tektronix	TDS 2012C	*Oct 19*	*Oct 21*	*568*
Miniature Flat, Zero-Biased Schottky Detector –0.1– 18 GHz	Narda	4503A-03	*Val. bevor use*	*Val. bevor use*	*613*
Digital-Vacuum-/Barometer	Greisinger	GDH-200-14	*Oct 19*	*Oct 21*	*632*
EMI Test receiver ESW26	Rohde & Schwarz	R&S ESW26 (SN: 101383/26 SW: R&S ESW1.61))	*Nov 19*	*Nov 21*	*665*
Signal analyser Keysight 50GHz	Keysight	UXA N9040B (SN: MY57213006 SW: A.24.58/2019.0702)	*Nov 19*	*Nov 21*	*666*
7. test/control software					
EMC32	Rohde & Schwarz	V10.60.20	---	---	---
Maturo mcApp	Maturo	SW: V3.4.9.4537 (19.04.04)	---	---	---
SPS EMC	Spitzenberger & Spies	SW: V4.1.3	---	---	---
EMV-Soft	Schlöder GmbH	SW: V11.95	---	---	---
ISMISO	EM Test AG	SW:V3.63	---	---	---

List of external test equipment

Equipment TÜV NORD CERT GmbH EMV Services

Status / State Aug. 02, 2021						
Marking	**Manufacturer**	**Type**	**Serial-No.**	**Last Cal.**	**Next Cal. (±1 Month)**	**No.**
V-LISN	Schwarzbeck	NSLK 8127	8127-463	Oct 20	Sep 23	414
Pulse limiter	Rohde & Schwarz	ESH3-Z2	No. 2	Oct 20	Sep 23	418
Bilog Antenna	CHASE Electronics	CBL6112	2082	Feb 20	Jan 23	305
EMI-Test Receiver	Rohde & Schwarz	ESW44	101704	Feb 20	Aug 21	145

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11. List of test cables

Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
3	N	0,5 - 8000	3	Cellflex
4	N	0,5 - 8000	3	Cellflex
4a	BNC	10 – 1500	0.50	Telemeter
12a	N	10 – 265000	6	Huber + Suhner
14a	BNC	10 – 1000	1.00	Telemeter
17a	APC3.5	10 – 26500	2.13	Huber + Suhner
18a	APC3.5	10 – 26500	2.13	Huber + Suhner
22	BNC	10 – 1000	1.50	---
27	BNC	10 – 1000	1.00	Fabrica Milanese Cond.
40	BNC	---	0.50	Aircell
43	SMA	10 – 18000	0.50	Rosenberger
44	SMA	---	0.50	Huber + Suhner
45	SMA	10 – 18000	0.50	Huber + Suhner
48	SMA		0.50	Huber + Suhner
49	N	10 – 18000	1.00	Huber + Suhner
50	N	10 – 18000	1.00	Huber + Suhner
51	N	10 – 18000	1.00	Huber + Suhner
52	N	10 – 18000	1.00	Huber + Suhner
54	BNC	10 – 3500	1.00	Aircell
58	N	10 – 18000	2.00	Huber + Suhner
59	N	10 – 18000	1.00	Huber + Suhner
60	N	10 – 18000	2.00	Huber + Suhner
61	N	10 – 18000	1.00	Huber + Suhner
62	SMA	---	0.50	Huber + Suhner
63	SMA	10 – 18000	0.50	Huber + Suhner
64	SMA	10 – 18000	0.50	Huber + Suhner
65	APC3.5	10 – 26500	0.60	---
66	APC3.5	10 – 26500	0.60	---
67	APC3.5	10 – 26500	0.60	---
68	APC3.5	10 – 26500	0.60	---
72	BNC	---	0.40	---
73	BNC	---	0.40	---
76	SMA	10 – 30000	3.00	Gore
79	BNC/N	10 – 1000	5.00	---
80	SMA	---	0.25	Huber + Suhner
87	SMA	10 – 18000	0.15	Huber + Suhner
88	SMA	10 – 18000	0.15	Huber + Suhner
89	SMA	10 – 18000	0.15	Huber + Suhner
90	SMA	10 – 18000	0.15	Huber + Suhner
91	SMA	---	1.50	Huber + Suhner
94	BNC	---	1.10	---
95	BNC	---	0.80	---
96	BNC	---	0.80	---
100	N	10 – 26500	6.00	Rosenberg
101	N	10 – 18000	2.90	Huber + Suhner
102	SMA	10 – 18000	2.00	Huber + Suhner
111	BNC	10 – 1000	0.50	---
112	BNC	10 – 1000	0.50	---
114	SMA	10 – 18000	0.25	Huber + Suhner
116	SMA	10 – 18000	0.25	Huber + Suhner
119	N	10 – 20000	8.00	Jyebao
121	SMA	10 – 18000	1.50	Huber + Suhner
122	SMA	10 – 18000	2.00	Huber + Suhner

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Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
123	SMA	10 – 18000	2.00	Huber + Suhner
145	SMA	10 – 26500	8.00	Huber + Suhner
147	APC3.5	10 – 40000	1.50	Jyebao
148	APC3.5	10 – 40000	3.00	Jyebao
151	SMA	10 – 18000	0.50	Rosenberger
152	SMA	10 – 18000	0.50	Rosenberger
154	BNC	10 – 1000	1.00	---
155	N/BNC	---	0.85	---
157	BNC	---	0.50	---
158	SMA	10 – 26500	2.00	Huber + Suhner
160	SMA	10 – 18000	0.40	Nortel Networks
161	SMA	10 – 18000	1.00	Huber + Suhner
162	APC35	10 – 26500	2.00	Huber + Suhner
163	APC3.5	10 - 26500	2.00	Huber + Suhner
164	APC3.5	10 – 26500	2.00	Huber + Suhner
165	APC2.9	10 – 26500	2.00	Huber + Suhner
166	APC3.5	10 – 40000	---	---
167	APC3.5	10 – 40000	1.00	Jyebao
168	APC3.5	10 – 40000	1.00	Jyebao
169	APC3.5	10 – 40000	1.00	Jyebao
170	APC3.5	10 – 40000	1.00	Jyebao
171	APC3.5	10 – 40000	1.00	Jyebao
172	SAM	---	0.90	Huber + Suhner
173	APC	10 – 26500	2.00	Huber + Suhner
174	APC	10 – 26500	---	Huber + Suhner
175	SMA	10 – 18000	0.40	Huber + Suhner
176	N-SMA	10 – 18000	0.50	Huber + Suhner
188	N	10 – 18000	5.00	Huber + Suhner
EMV 1	BNC	---	2.00	Henn
EMV 2	BNC	10 – 1000	2.00	Henn
EMV 4	BNC	---	9.70	Henn
EMV 5	BNC	---	3.80	Henn
EMV 6	BNC/N	10 – 1000	5.00	Lüthi
EMV 7	BNC	10 – 1000	1.50	Henn
EMV 8	BNC	10 – 1500	1.70	Henn
EMV 9	BNC	10 – 1000	1.70	Henn
EMV 11	BNC	---	5.20	Hasselt
EMV 12	BNC	10 – 1000	2.40	Hasselt
EMV 13	BNC	10 – 1000	4.10	Hasselt
EMV 14	BNC	10 – 1000	2.50	Hasselt
EMV 15	BNC	---	0.90	Henn
EMV 16	Fischer	---	2.00	---
EMV 18a	Fischer	---	1.00	---
EMV 19a	Fischer	---	1.50	---
KISN2	BNC	10 – 2000	4.80	---

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End of test report

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